THE BEHAVIOR OF HEMP UNISEXUAL FEMALE HYBRIDS COMPARATIVE WITH THE MONOIC PARENTAL FORM, UNDER THE INFLUENCE OF APPLIED CUTS

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Abstract

The paper aims to highlight the agroproductivity of unisexual female hybrids from three generations (HUF1, HUF2 and HUF3) compared with Zenit monoic parental form. The researches were carried out between 2015 – 2016, in A.R.D.S Secuieni experimental field. The experience was of bifactorial type, following the biometric characters and seed yields of the studied genotypes, under the influence of applied cuts during the vegetation period. The obtained results showed that, on average over the two experimental years, the seed yields were statistically ensured at a very significant level for T2 (two cuts – 1319.7 kg/ha), respectively distinctly significant for T1 (one cut – 1238.7 kg/ha) compared with the uncut variant (control). The interaction between cutting x genotype factors has generated, on average, very significant yield differences for the combinations of HUF2 and the three cuttings (NT x HUF2 – 175.3 kg/ha, T1 x HUF2 – 361.6 kg/ha, T2 x HUF2 – 480.6 kg/ha). Very significant productions were also provided by the combinations between HUF1 and HUF3 hybrids and the T1 and T2 cuttings.

Key words: unisexual female hybrid, cutting, agroproductivity

Hemp, in addition to many industrial uses, is a complex food with many health benefits. Hemp seeds are some of the richest sources of food in the world, do not have trypsin inhibitors and do not cause allergies (Hanks, 2008). They contain all eight essential amino acids (arginine, leucine, lysine, methionine, phenyalanine, tryptophan, valine, threonine) and the perfect ratio of essential fatty acids Omega 3 and Omega 6 (Mediavilla V. et al., 1999; Lesson and Pless, 1999; Oomah B. D. et al., 2002; Orhan I. et al., 2000). The husked seeds contain 34.6% protein, of which over 50% is a lightly digestible protein (edestina), stimulating the production of antibodies, 46.5% fat and 11.6% carbohydrates.

Besides the fact that the regular consumption of hemp seeds can prevent diseases such as Parkinson and Alzheimer and can alleviate the symptoms of anxiety and depression, the premenstrual symptoms of menopause can be treated due to their content in gamma-linolenic acid, being beneficial in maintaining hormonal balance (Găucă C., 1990; Pop Georgeta et al., 2012; Alexa Ersilia et al., 2012). The „Secuieni method" used in the conducted experiments consists in the application of two cuts in hemp crop, the first in the 5 to 6 leaf stage, at a height of 20 - 25 cm from the ground level, and the second at 15 - 20 cm above the first cut (Popa Diana et al., 2015; Alexandra Leonte et al., 2015).

MATERIAL AND METHOD

During 2015 – 2016 period, within A.R.D.S. Secuieni, was established a bifactorial experience of type A X B, placed after according to the subdivided parcels method, in three repetitions, in which the A factor was represented by the cutting type with three graduations (a_1 – NT, a_2 – T1 and a_3 – T2), and the B factor by the experimented genotype with 4 graduations (b_1 – Zenit, b_2 – HUF 1, b_3 – HUF 2 and b_4 – HUF 3).

The tested genotypes were repesented by a monoecious variety and three unisexual female hybrids.

The Zenit variety was obtained by hybridization, backcrossing and selection, from 237/1995 monoecious line, as a male partner, and HUF 210/1994 unisexed female line, as a female partner. It is a monoecious variety specific for seed, ensuring large yields of 1100 – 1500 kg/ha, as well as a yield of 8 – 9 t/ha strains. The THC content is below 0.2% (Găucă C. et al., 2015).

The hybrids belong to the three generations of crossbreeding and backcrossing between a local population (femel partner) and Zenit variety (male partner).

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The location of the experience was carried out each year on a medium-textured typical chernozem cambic soil characterized as poorly supplied in potassium (124.6 ppm K_2O), medium supplied in active humus (1.88%) and nitrogen (16.2 ppm $N\text{-}NO_3$), well supplied in phosphorus (77.6 ppm PAL), calcium (13.6 meq/100 g sol Ca) and magnesium (1.8 meq/100 g sol Mg) and having a pH slightly acidic (pH_{H2O} – 5.98).

The fertilization of the experiments was realized with 110 kg/ha N a.s., 40 kg/ha P_2O_5 and 40 kg/ha K_2O, and the herbicidation with 1.0 l/ha Fusilade, 0.5 l/ha Lontrel and 1.5 l/ha Dual Gold. The sowing was carried out on 28 of April 2015, respectively on 26 of April 2016, and the emergence took place on May 7, 2015, respectively on May 5, 2016. The plant density, both in the first year of experimentation and also in the second year, was of 28 plants/sqm. The moment of the first cut applying was June 12, 2015, respectively June 6,2016, and of the second cut was July 6, 2015, respectively June 24, 2016.

The hemp vegetation period has been characterized, from the temperatures point of view, as warm in 2015 and very warm in 2016. During this period, the deviations from the multiannual average ranged between 1.9^0C (2015) and 3.3^0C (2016). From the pluviometric point of view, the vegetation period was very dry in 2015 and rainy in 2016. The deviations from the multiannual rainfall average were between -233.3 mm (2015) and 21.1 mm (2016) (*table 1*).

The samples harvesting was done manually, on September 22, 2015, respectively on September 1, 2016, and the harvested area was of 10 m^2.

As far as the experimental data are concerned, they were processed by statistical methods specific to the polyfactorial experiences, and their interpretation was made by the variance analysis (Ceapoiu N., 1968).

Table 1

Temperatures and rainfall recorded at A.R.D.S. Secuieni weather station

		Months									Average of veg. period	Deviation	Veg. period caract.
		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.			
Average temp. (°C)	2015	-1.6	-0.2	4.5	9.5	16.6	20.1	22.8	22.4	18.4	18.3	1.9	warm
	2016	-3.0	4.2	5.7	13.5	14.9	20.3	31.7	20.6	17.3	19.7	3.3	very warm
	multiannual average	-3.8	-2.3	2.6	9.4	15.4	18.8	20.3	19.5	14.9	16.4	-	-
Rainfalls (mm)	2015	8.8	16.0	43.4	25.4	5.6	34.0	51.0	12.6	24.8	153.4	-233.3	very droughty
	2016	12.0	14.2	29.4	42.0	120.2	161.0	4.0	32.0	48.6	407.8	21.1	rainy
	multiannual average	20.5	19.6	25.4	46.8	64.8	84.3	84.0	61.4	45.4	386.7	-	-

RESULTS AND DISCUSSIONS

The morphological and biometric characters of the studied genotypes were influenced by the type of cut applied. Thus, both the size and average diameter of plants decreased as the number of cuttings increased. At the same time, the recorded data reveals a direct correlation between the number of ramifications on the plant and the cuts made (*table 2*).

In 2015, the cuts have influenced the seed production, the two cuttings carried out recording distinctly significant production increases (202.7 kg/ha), while the single-cut variant produced significant production differences (139.6 kg/ha) compared with the uncut control (*table 3*).

At the level of 2015, the clear influence of the studied genotype on seed yield was observed. All three generations of unisexed female hybrids have achieved statistically significant production increases (HUF 2 – 311.1 kg/ha, HUF 1 – 177.7 kg/ha, HUF 3 – 176.4 kg/ha) compared with Zenit parental variety (984.5 kg/ha) (*table 4*).

The cutting x variety interaction, has influenced, in 2015, the hemp seed production, this ranging between 940 kg/ha (NT x Zenit) and 1433.3 kg/ha (T2 x HUF2). The three unisexed female hybrids generated, for both cutting varieties (T1 and T2), very significant production increases compared to the control variant (NT x Zenit – 940 kg/ha), the highest value being recorded by HUF2 to which two cuttings were applied (T2 x HUF2 – 493.3 kg/ha). Also, distinctly significant differences were obtained from the HUF2 hybrid to which no cutting was applied (186.7 kg/ha), while the NT x HUF 3 interaction determined a significant production increase (120.0 kg/ha) (*table 5*).

For 2016, the influence of the experimented A factor (cutting type) it was observed in the case of the variants in which the "Secuieni method" of cultivation was applied, these registering production results ensured as very significant at a

statistical level (T2 – 1399.5 kg/ha, T1 – 1301.0 kg/ha) versus the uncut variant (NT – 1154.5 kg/ha) (*table 6*).

The experimented genotype have influenced the seed production throughout 2016, these ranging from 1175.4 kg/ha (Zenit variety) to 1398.1 kg/ha (HUF2 hybrid). The production increases obtained by the three generations of hybrids were very significant (HUF2 – 222.7 kg/ha, HUF3 – 145.9 kg/ha, HUF1 – 69.7 kg/ha) compared to Zenit parental variety (table 7).

The interaction between the two studied factors (cut x variety) has decisively influenced the seed production in 2016, all the combinations registering statistically significant outputs compared to the control variant (NT x Zenit). The yields varied between1075 kg/ha (NT x Zenit) and 1543.3 kg/ha (T2 x HUF 2). Nine combinations determined very significant differences (T2 x HUF2, T2 x HUF3, T1 x HUF2, T1 x HUF3, T2 x HUF1, NT x HUF2, T1 x HUF1, T2 x Zenit, T1 x Zenit), the other two being significantly distinct (NT x HUF1), respectively significant (NT x HUF3) (*table 8*).

During the experimental period, the applied cuttings have influenced the achieved seed yield, this ranging from 1095.8 kg/ha (NT) to 1319.7 kg/ha (T2). Both graduations of the cutting factor determined statistical increases, the variant cut twice being distinguished by very significant production differences (T2 - 223.9 kg/ha) compared to the control variant (NT), while at the variant with one cut, the yields were distinctly significant (T1 - 142.9 kg/ha) (*table* 9).

The 2015 – 2016 period provided, on average, for the three studied unsexed female hybrids, very significant production differences (HUF2 – 266.8 kg/ha, HUF3 – 161.1 kg/ha, HUF1 – 123.9 kg/ha) compared to Zenit parental form. Similar to each experienced year, the HUF2 hybrid generated the highest seed yields (1346.9 kg/ha) (*table 10*).

The combination of cutting x genotype factors generated very large variations in seed production, the values being between 1007.7 kg/ha (NT x Zenit) and 1488.3 kg/ha (T2 x HUF2). Significantly positive values statistically ensured, due to the comparison with the control variant (NT x Zenit), recorded all the interactions between the two experienced factors. Of these, seven combinations have determined very high production yields, the highest value being recorded by HUF2 hybrid to which two cuttings were applied (480.6 kg/ha) (*table 11*).

Table 2

Morphological and biometric characteristics of the studied hemp genotypes (2015-2016)

Genotype	Cutting type	Size	Number of ramifications	Average diameter
Zenit	NT	223	-	10.2
	T1	179	59	8.2
	T2	135	132	5.4
HUF1	NT	230	-	9.7
	T1	180	58	8.9
	T2	150	134	5.9
HUF2	NT	225	-	9.9
	T1	172	57	8.1
	T2	132	107	5.4
HUF3	NT	217	-	9.7
	T1	169	58	8.5
	T2	130	129	5.3

Table 3

The influence of cuts on seed yield in 2015

Cutting type	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
NT	1036.7	100.00	Mt
T1	1176.3	139.6	139.6 x
T2	1239.4	202.7	202.7xx
	DL 5% = 120. kg/ha DL 1% = 199.7 kg/ha DL 0.1% = 372.9 kg/ha		

Table 4

The influence of genotype on seed yield in 2015

Genotype	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
Zenit	984.5	100.00	Mt
HUF1	1162.2	118.05	177.7^{xxx}
HUF2	1295.6	131.60	311.1^{xxx}
HUF3	1160.9	117.92	176.4^{xxx}
	DL 5% = 67.6 kg/ha DL 1% = 92.8 kg/ha DL 0.1% = 126.3 kg/ha		

Table 5

The influence of cutting x genotype interaction on seed yield in 2015

Cutting x genotype	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
NT x Zenit	940.0	100.00	Mt
NT x HUF1	1020.0	108.51	80.0
NT x HUF2	1126.7	119.86	186.7 ^{xx}
NT x HUF3	1060.0	112.77	120.0 ^{x}
T1 x Zenit	996.7	106.03	56.7
T1 x HUF1	1180.0	125.53	240.0 ^{xxx}
T1 x HUF2	1326.7	141.14	386.7 ^{xxx}
T1 x HUF3	1201.7	127.84	261.7 ^{xxx}
T2 x Zenit	1016.7	108.16	76.7
T2 x HUF1	1286.7	136.88	346.7 ^{xxx}
T2 x HUF2	1433.3	152.48	493.3 ^{xxx}
T2 x HUF3	1221.0	129.89	281.0 ^{xxx}
	DL 5% = 117.2 kg/ha DL 1% = 160.7 kg/ha DL 0.1% = 218.7kg/ha		

Table 6

The influence of cuts on seed yield in 2016

Cutting type	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
NT	1154.5	100.00	Mt
T1	1301.0	112.69	146.5 ^{xxx}
T2	1399.5	121.22	245.0 ^{xxx}
	DL 5% = 23.0 kg/ha DL 1% = 38.2 kg/ha DL 0.1% = 71.3 kg/ha		

Table 7

The influence of genotype on seed yield in 2016

Genotype	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
Zenit	1175.4	100.00	Mt
HUF1	1245.1	105.93	69.7 ^{xxx}
HUF2	1398.1	118.95	222.7 ^{xxx}
HUF3	1321.3	112.41	145.9 ^{xxx}
	DL 5% = 33.4 kg/ha DL 1% = 45.8 kg/ha DL 0.1% = 62.3 kg/ha		

Table 8

The influence of cutting x genotype interaction on seed yield in 2016

Cutting x genotype	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
NT x Zenit	1075.0	100.00	Mt
NT x HUF1	1163.7	108.25	88.7 xx
NT x HUF2	1239.0	115.26	164.0 xxx
NT x HUF3	1140.3	106.07	65.3 x
T1 x Zenit	1220.0	113.49	145.0 xxx
T1 x HUF1	1231.7	114.58	156.7 xxx
T1 x HUF2	1412.0	131.35	337.0 xxx
T1 x HUF3	1340.3	124.68	265.3 xxx
T2 x Zenit	1231.3	114.54	156.3 xxx
T2 x HUF1	1340.0	124.65	265.0 xxx
T2 x HUF2	1543.3	143.56	468.3 xxx
T2 x HUF3	1483.3	137.98	408.3 xxx
			DL 5% = 57.8 kg/ha DL 1% = 79.3 kg/ha DL 0.1% = 108.0kg/ha

Table 9

The influence of cuts on seed yield during 2015 - 2016

Cutting type	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
NT	1095.8	100.00	Mt
T1	1238.7	113.4	142.9 xx
T2	1319.7	120.43	223.9 xxx
			DL 5% = 61.7 kg/ha DL 1% = 102.4 kg/ha DL 0.1% = 191.2 kg/ha

Table 10

The influence of genotype on seed yield during 2015 - 2016

Genotype	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
Zenit	1080.1	100.00	Mt
HUF1	1204.0	111.47	123.9 xxx
HUF2	1346.9	124.70	266.8 xxx
HUF3	1241.2	114.92	161.1 xxx
			DL 5% = 40.3 kg/ha DL 1% = 55.3 kg/ha DL 0.1% = 75.3 kg/ha

Table 11

The influence of cutting x genotype interaction on seed yield during 2015 - 2016

Cutting x genotype	Seed production		
	Production (kg/ha)	% vs. control	Difference (kg/ha)
NT x Zenit	1007.7	100.00	Mt
NT x HUF1	1092.0	108.37	84.3 x
NT x HUF2	1183.0	117.40	175.3 xxx
NT x HUF3	1100.3	109.19	92.6 x
T1 x Zenit	1108.3	109.98	100.6 xx
T1 x HUF1	1206.3	119.71	198.6 xxx
T1 x HUF2	1369.3	135.88	361.6 xxx
T1 x HUF3	1271.0	126.13	263.3 xxx
T2 x Zenit	1124.3	111.57	116.6 xx
T2 x HUF1	1313.7	130.37	306.0 xxx
T2 x HUF2	1488.3	147.69	480.6 xxx
T2 x HUF3	1352.3	134.20	344.6 xxx
			DL 5% = 69.8 kg/ha DL 1% = 95.8 kg/ha DL 0.1% = 130.4 kg/ha

CONCLUSIONS

For the four experimental genotypes, the morphological and biometric characters were influenced by the number of cuttings applied. The plant height and average diameter were in a regression relationship with the type of cutting, while a direct correlation was recorded between the number of branches on stem and the cuttings applied.

During 2015 – 2016, the variant with two cuts recorded production increases ensured at a significant level (T2 – 223.,9 kg/ha) compared to the control variant (NT – 1095.8 kg/ha).

The two experimental years have revealed the productive potential of the three unisexed female hybrids, with very significant production differences (HUF2 – 266.8 kg/ha, HUF3 – 161.1 kg/ha, HUF1 – 123.9 kg/ha) compared to the control variant (Zenit – 1080.1 kg/ha).

The influence of the cutting x genotype interaction, during 2015 – 2016 period, generated production increases statistically ensured as very significant for seven of the studied combinations, due to the comparison with the control variant (NT x Zenit). Of these, the highest seed yield was recorded at T2 x HUF2 variant (1488.3 kg/ha).

At the level of the studied period, has detached, in terms of seed production, the HUF2 hybrid, with the highest increases, statistically assured, compared to Zenit parental form, while the two cutting variant produced the best results, with statistical significance, as compared to the uncut variant.

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